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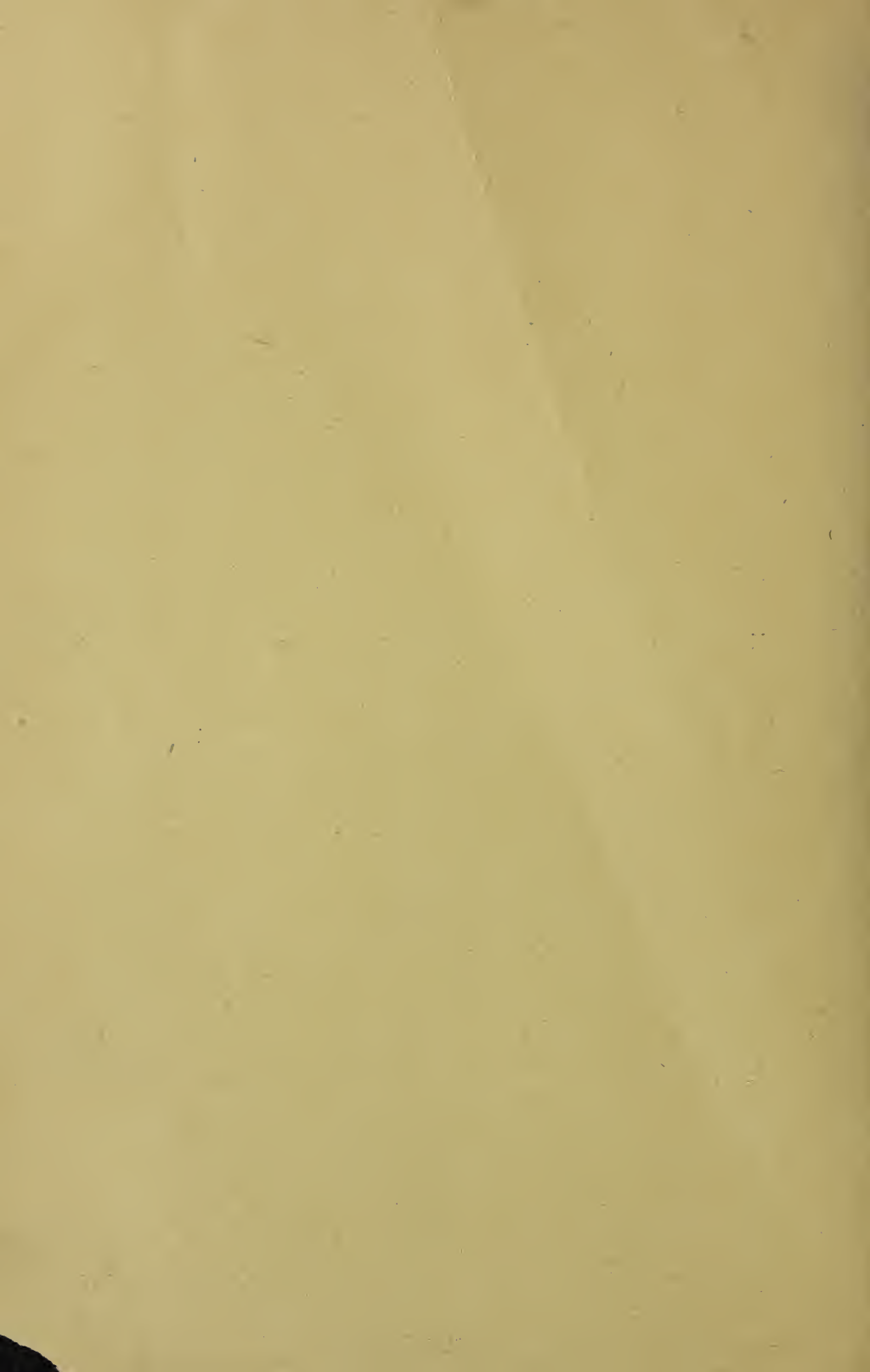
THE ELECTRIC BUREAU
OF THE
DEPARTMENT OF PUBLIC SERVICE
CITY OF CHICAGO



ROOM 613, CITY HALL
Telephones: Main 236; Automatic 32-854

MONTAGUE FERRY, Commissioner

OCTOBER 1, 1914



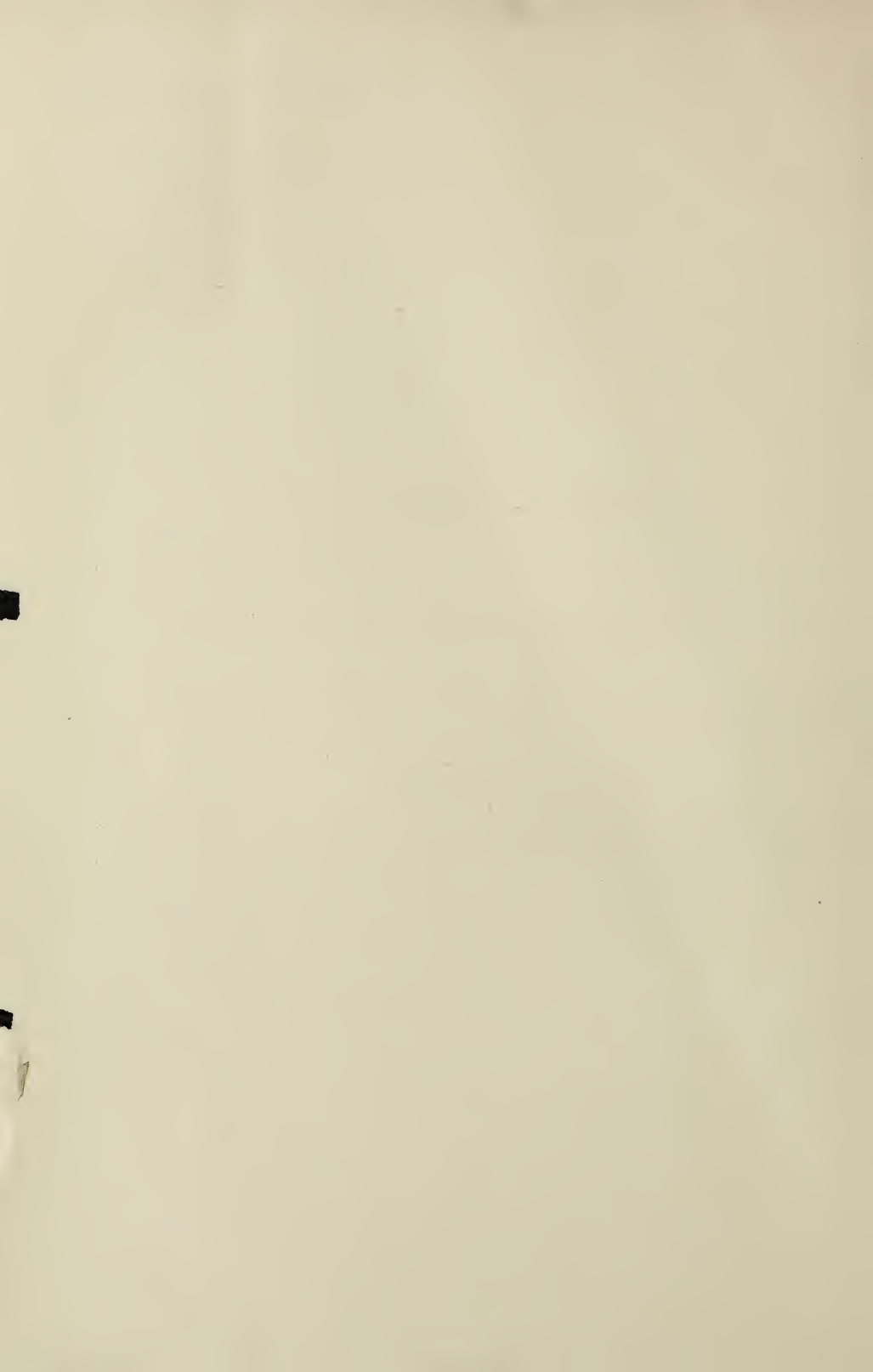
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BUREAU ORGANIZATION.

Supervisor of Electric Light and Power	C. E. Schutt
Assistant Supervisor of Electric Light and Power	F. J. Leimer
Service Inspectors	Special Investigators
Meter Testers	Stenographers



September 26, 1914.

To the Hon. Carter H. Harrison, Mayor,
and Aldermen of the City Council Assembled:

Gentlemen:—

I have the honor to submit herewith a report of the Electric Bureau of the Department of Public Service.


The work of this Bureau is in charge of Supervisor C. E. Schutt, who has had many years' experience as consulting engineer in the electrical field. He has done expert work for municipalities in Indiana and Ohio, and has had operating experience in several utility companies. I consider the results accomplished by Mr. Schutt during the summer to be very important. His defense of the interests of Chicago in connection with the electric rules proposed to be issued by the State Public Utilities Commission of Illinois was very ably conducted before the Commission on July 16th, last.

An ordinance covering the testing of electric meters is submitted in the report and has been referred to your Committee on Gas, Oil and Electric Light for attention.

A valuable public service is being rendered in the work of service inspection with the result that a knowledge of the application of rates and the quality of service is being obtained which could not be secured in any other way.

Respectfully submitted,

M. FERRY,
Commissioner of Public Service.



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GENERAL.

The activities of the Electric Bureau during the months of July, August and September has been confined chiefly to six problems.

- (1) Service conditions in the City of Chicago.
- (2) Analyses of the factors affecting the consumers' bills for electricity.
- (3) Rules for electric service—State Commission.
- (4) Complaints.
- (5) Statistics.
- (6) Elevated railways valuation (Special Items).

Investigation of conditions under which electricity is being sold has led to action looking toward standardization. An ordinance covering meter tests is needed; the proposed ordinance (page 8), drawn to conform with state statutes, should be passed and enforced.

Rate problems require detailed analysis to determine reasonableness of rates as affecting the income of the utility companies, and injustice or discrimination in rate fixing. Tangible results may be attained by explaining to consumers the factors affecting their bills.

The handling of complaints has occupied considerable time—well spent. Much valuable assistance has been rendered consumers and in a number of cases important facts have been brought to the attention of the department—notably, considerations involved in the furnishing of service to consumers where street mains must be extended. Since August, the Commonwealth Edison Company has, due to retrenchments, failed to furnish prospective consumers with service where an extension of mains was necessary, unless the consumer deposits with the company a sum equal to the cost of making such extension.

SERVICE IS DENIED.

The previous practice of the company, that of extending service to all who ask it has educated the public to consider electric service as available to all residents of Chicago. A rude awakening has brought the people face to face with the problem of obtaining this commodity which has come to be regarded as a universal necessity.

The collection of valuable information regarding the present existing regulatory measures and compliance therewith is being constantly pursued.

The problem of solving the tangled conditions affecting the supplying of electricity to consumers is one that is constantly engaging the attention of regulating bodies. In attempting a solution scientific treatment and analysis may not be considered apart from practical considerations. New factors are being discovered which may either simplify matters or cause further complications.

Much engineering work must be done by Chicago coupled with investigation of our local conditions. Other states and municipalities are compiling information and performing research work for the improvement of conditions at large. Their findings are of value as a guide to similar work in Chicago. But the problems peculiar to this city are of such great local importance as to require thorough analysis and persistent investigation.

TENTATIVE RULES FOR ELECTRIC SERVICE OF THE STATE PUBLIC UTILITY COMMISSION OF ILLINOIS.

The State Public Utility Commission of Illinois since July of this year has had before it the question of rules regarding the supply of electricity. Representatives of the City of Chicago recently appeared before the Commission with the contention that in framing rules, adequate consideration had not been given to Chicago conditions and asked for certain changes.

In the comparison set forth below, the proposed rules of the State Public Utility Commission of Illinois are printed with the required changes and comments.

Rule 15. Creeping Meters. No electricity meter which registers upon "no load" shall be placed in service or allowed to remain in service.

Rule 16. Allowable Errors. No electricity meter shall be placed in service or allowed to remain in service which has an incorrect register constant, test constant, gear ratio, or dial train, or which has an error in measurement in excess of 4% between one-tenth and full connected load.

These two rules are covered in the proposed city ordinances as follows: "When any consumer's meter is tested as in this section provided and is found inaccurate, it shall be adjusted so as to register within one percent (1%) any and all amounts of electricity passing through the said meter when such amounts are between ten percent (10%) of and one hundred percent (100%) of the rated capacity of the said meter.

"Any meter which 'creeps' or registers when no electricity is passing through the same, shall be removed from service within thirty days after notice thereof given by the Commissioner of Public Service, to the seller."

Rule 16 is completely covered also by an already existing city ordinance.

Rule 17. Installation Tests. Each watt-hour meter shall be checked for correct connection, mechanical conditions, suitable location and accuracy of measurement at approximately three-quarters and one-tenth connected load by comparing the meter with approved suitable standards in its permanent position in place of service within thirty days after installation. Meters operating at low power-factor shall also be tested at approximately the minimum power-factor under which they will be required to operate. Meters installed with instrument transformers or shunts must be tested jointly with transformers or shunts, otherwise, the ratio of transformation of the transformers or calibration of the shunts must be determined at least once every five years.

"All consumers' meters hereafter installed shall be tested as hereinafter prescribed within ninety (90) days after such installation. Such test shall be termed within the meaning of this ordinance, 'installation test.'"

Rule 18. Periodic Tests. Each watt-hour meter shall be tested according to the following schedule and adjusted whenever it is found to be in error more than one percent, the test both before and after adjustment being made at approximately three-quarters and one-tenth of the rated capacity of the meter. Meters operated at low power-factor shall also be tested at approximately the minimum power-factor under which they will be required to operate. The tests shall be made by comparing the meter, while connected in its permanent position on the consumer's premises with approved, suitable standards, making at least two test runs at each load, of at least thirty seconds each, which agree within one percent.

Two and three wire commutating type and mercury type meters up to and including fifty (50) amperes rated capacity of meter element shall be tested at least once every eighteen (18) months.

Two and three wire commutating type and mercury type meters of over fifty (50) amperes rated capacity of meter element, shall be tested at least once every twelve (12) months.

Two and three wire single phase induction type meters, up to and including twenty-five (25) amperes rated capacity of meter element, and manufactured prior to January 1, 1907, shall be tested at least once every thirty (30) months. Meters of the same type and rating manufactured since January 1, 1907, shall be tested at least once every thirty-six (36) months.

Two and three wire single phase induction type meters of over twenty-five (25) amperes rated capacity of meter element, shall be tested at least once every twenty-four (24) months.

Self contained polyphase meters up to and including 50 K. W. rated capacity, shall be tested at least once every eighteen (18) months.

Self contained polyphase meters of over 50 K. W. shall be tested at least once every twelve (12) months.

Polyphase meters connected through current transformers or current and potential transformers, to circuits of over fifty (50) K. W. rated capacity, shall be tested at least once every eighteen (18) months.

In no case shall commutator type meters having heavy moving elements and sapphire jewels, be allowed to make more than 1,000,000 revolutions between tests. Where meters are found to register considerably in error when tested on the above schedule the Commission reserves the right to order the particular meter or class of meters tested more frequently.

An objection was offered before the Commission to the complexity of this rule. The proposed ordinance of the City of Chicago covers the subject of periodic tests in the following manner: "All consumers' meters shall be tested as hereinafter prescribed at least once in every two years. Such tests shall be termed 'periodic tests.'"

Rule 19. Meter Tests Records. Whenever an electricity meter is tested the original test record shall be kept indicating the information necessary for identifying the meter, the reasons for making the test, the reading of the meter before being disturbed, the statement regarding creepage and the accuracy of measurement together with all data taken at the time of the test. This record must be sufficiently complete to permit the convenient checking of the methods and the calculations. All utilities having more than 250 electricity meters in service shall maintain a meter record, numerically arranged, indicating approximately when the meter was purchased, its identification, its various places of installation with dates of installation and removal and the data and general results of all tests, and shall tabulate the results of tests according to type of meters and intervals of tests, compiled monthly and annually.

This rule is covered both in an existing city ordinance and in Section 10 of the proposed ordinance.

Rule 20. Meter Testing Equipment. Each utility furnishing metered electric service shall own suitable working standards for the testing of electricity meters and even maintain these standards correct within one-half of one percent or apply the proper correction to all tests. Secondary standards of some approved type shall be owned and maintained by each utility having more than 250 electricity meters in service.

In the proposed city ordinance covering the testing of electric meters, the maintenance of standard instruments is not required by the sellers of electricity. Such companies, however, as do maintain proper standards and methods of testing may be allowed to make installation and periodic tests upon meters belonging to them under provision as follows:

"Section 4, Paragraph 2. All installation tests and all periodic tests shall be made by the Commissioner of Public Service or his representative, or by such person or persons competent to make such tests, as the Commissioner of Public Service shall, in writing, authorize. Such tests shall be made at the expense of the seller and the said seller shall pay for all such tests made by the Commissioner of Public Service or his representative, to the Collector of the City of Chicago, the fee or fees hereinafter prescribed."

Rule 21. Request Tests. Each utility furnishing metered electric service shall make a test of the accuracy of any electricity meter upon request of the consumer, provided the consumer does not request such tests more frequently than once in six months. A report giving the result of each request test shall be made to the consumer and the complete, original record kept on file in the office of the utility.

Rule 22. Referee Tests. Any electricity meter may be tested by an inspector employed by the commission, upon written application of the consumer. For such test a fee shall be forwarded to the commission by the consumer when making application; the amount of this fee shall be refunded to the consumer by the utility if the meter is found to be fast beyond the 4% limit. The amount of fee to be collected for these tests so made shall be \$2.00. For each single phase or continuous current electricity meter having a voltage rating not exceeding 250 volts, and a current capacity not exceeding 25 amperes without having instrument transformers; for other electricity meters having a capacity not exceeding 100 amperes the test fee shall be \$4.00 per meter; for all others the fee shall be \$8.00 per meter.

The provisions of these two rules of the State Commission are covered in the proposed city ordinance as follows:

"Section 3, Paragraph 3. Whenever any person shall make application to the Commissioner of Public Service for a test of any consumer's meter, and shall present the receipt hereinafter prescribed, such test as hereinafter prescribed shall be made by the Commissioner of Public Service or his representative, and shall be termed within the meaning of this ordinance 'complaint test.'"

"Section 4, Paragraph 1. Any person making application for complaint test shall deposit with the Collector of the City of Chicago, the fee or fees hereinafter prescribed and he shall receive from the said Collector of the City of Chicago, a receipt, which shall state the amount of the fee or fees deposited, the name of the person making said application, the name of the seller, the location of the said consumer's meter, the rating of the said consumer's meter in amperes and the voltage of the connected circuit."

The fees for the test of any electric meter by the City of Chicago are provided in Section 7 of said ordinance and the test which shall be applied to any meter is defined in Section 8, Paragraph 3, of said ordinance.

Rule 26. Extension of Street Mains. Every electric utility should set free two (2) poles and furnish free necessary wires for an extension, up to 200 feet, of an overhead street main for any consumer who may request such service.

Any street main extension requested by a prospective consumer for any point within the corporate limits of any city or village or for any immediate adjacent suburb or addition to a city or village which shall require a length of line over and above the free limit, shall be made under the following conditions: The consumer requesting such service shall be obliged to deposit with the electric company an amount equal to the cost of such extension, and a rebate shall be made to the consumer whose service shall be taken off of said extension within a period of ten years, but at no time shall the rebate which is made exceed the original deposit made by the consumer.

If the extension beyond the free limit which is requested by the consumer is of such length and the prospective business which may be developed from such extension is so meager as to make it doubtful whether the business from the extension will ever pay a fair return on the investment, the facts shall be reported to the Utilities Commission for their investigation and determination as to the reasonableness of such extension.

At the time this rule was under discussion the following objections were offered by the representatives of the City of Chicago: The rule recognizes no diversity of demands among consumers of different classes, no comparative value of service, and no comparative value of returns. It provides for no method of return to the consumer of investment in extensions to an isolated consumer whose revenue should entitle him to a quick return of his deposit. The rule admits of discrimination between consumers in like but

not identical positions in that extensions may be made without request or request may be demanded. The rule makes such deposit obligatory when such extension is made upon request. Following is the rule which was offered as a substitute:

PROPOSED SUBSTITUTE FOR RULE 26—EXTENSION OF STREET MAINS.

"Every electric utility shall set two (2) poles and furnish necessary wires, free of cost to the consumer, for an extension up to 200 feet of an overhead street main, for any consumer who may request such service.

"Any street main extension requested by a prospective consumer for any purpose other than public lighting service for any point within the corporate limits of any city or village, or for any immediate adjacent suburb or addition to a city or village which shall require a length of line over and above the free limit, as herein defined, shall be made under the following conditions: the consumer requesting such service shall be required to deposit with the electric company an amount equal to the cost of such extension in excess of the free limit as defined above, and a rebate shall be made to the consumer equal to the cost of the length of free extension, for each consumer whose service shall be taken off said extension within a period of ten years, but at no time shall the rebate which is made exceed the original deposit made by the consumer.

"This rule shall not be construed to prohibit the entering into contract for extension of service, between a consumer and the utility, and providing other means of return to consumer of the investment in or deposit for extensions by consumer, provided such contract schedule is approved by the Commission and is applied without discrimination.

"If the extension beyond the free limit which is requested by the consumer or an extension for public lighting service is of such length and the prospective business which may be developed from such extension is so meager as to make it doubtful whether the business from the extension will ever pay a fair return on the investment, the facts shall be reported to the Utilities Commission for their investigation and determination as to the reasonableness of such extension."

Rule 27. **Voltage Variation.** Each electric utility operating in a city having a population of 1,500 or more shall adopt a standard voltage for the entire constant potential system and shall maintain the voltage within three percent of such standard on all lighting circuits during lighting hours; on power circuits and during other than lighting hours the voltage shall be maintained within ten percent of the standard. All other electric utilities shall maintain their voltage regulation on all constant potential circuits during lighting hours so that the maximum voltage furnished any consumer shall not be more than six percent above the minimum voltage at that consumer's cut-out.

Rule 27. The city ordinance of 1913 fixing the maximum rates for electricity furnished by the Commonwealth-Edison Company provides: "The voltage on any of said Commonwealth-Edison Company's distributing lines from which electricity for lighting purposes is furnished, shall, as measured at the consumer's service, not vary more than five percent (5%) either above or below the normal voltage carried by the circuit upon which the service is rendered; provided, however, that variations due to accidents or local conditions over which said Company has no immediate control, shall not be considered a violation of this provision until said Company shall have had notice in writing from a consumer affected and thirty (30) days' time in which to correct such conditions."

That a rule demanding very close voltage regulation when applied to the general case of distribution may work injustice both upon the operating company and the public was set forth in an argument presented to the State Commission at the time this rule was up for consideration. (See "Voltage Regulation.")

PROPOSED ORDINANCE PROVIDING FOR THE TEST, INSPECTION, SEALING AND ADJUSTMENT OF CONSUMERS' ELECTRIC METERS.

Be it ordained by the City Council of the City of Chicago that:

Section 1. The Duty of Commissioner of Public Service. Paragraph 1. It shall be the duty of the Commissioner of Public Service to provide for the test, inspection, sealing and adjustment of all meters as hereinafter defined, used or to be used in the City of Chicago in accordance with the provisions of this ordinance.

Section 2. Definition of Seller and Consumer's Meter. Paragraph 1. The term "seller" when used in this ordinance shall mean and include any corporation, company, association, joint stock company or association, firm, partnership, managing committee or individual, their lessees, trustees or receivers appointed by any court whatsoever (except, however, such public utilities as may now or hereafter be owned or operated by any municipality), that now or hereafter may own, control, operate or manage within the City of Chicago, directly or indirectly, any plant, equipment or property used or to be used for or in connection with the production, storage, transmission for sale, delivery, or furnishing of electricity, within the City of Chicago.

Paragraph 2. The term "meter" when used in this ordinance, shall mean and include each and every electrical device that is now, or that may hereafter be used for the purpose of measuring the electricity supplied to any consumer thereof.

Section 3. Definitions of Tests. Paragraph 1. All consumers' meters hereafter installed shall be tested as hereinafter prescribed within ninety (90) days after such installation. Such test shall be termed within the meaning of this ordinance "Installation Test".

Paragraph 2. All consumers' meters shall be tested as hereinafter prescribed at least once in every two years. Such test shall be termed within the meaning of this ordinance "Periodic Test".

Paragraph 3. Whenever any person shall make application to the Commissioner of Public Service for a test of any consumer's meter, and shall present the receipt hereinafter prescribed, such test as hereinafter prescribed shall be made by the Commissioner of Public Service or his representative, and shall be termed within the meaning of this ordinance "Complaint Test".

Section 4. Application for Complaint Test. Paragraph 1. Any person making application for complaint test shall deposit with the Collector of the City of Chicago, the fee or fees hereinafter prescribed and he shall receive from the said Collector of the City of Chicago, a receipt, which shall state the amount of the fee or fees deposited, the name of the person making said application, the name of the seller, the location of the said consumer's meter, the rating of the said consumer's meter in amperes and the voltage of the connected circuit.

Paragraph 2. All installation tests and all periodic tests shall be made by the Commissioner of Public Service or his representatives, or by such person or persons competent to make such tests, as the Commissioner of Public Service shall, in writing, authorize. Such tests shall be made at the expense of the seller and the said seller shall pay for all such tests made by the Commissioner of Public Service or his representative, to the Collector of the City of Chicago, the fee or fees hereinafter prescribed.

Paragraph 3. The Commissioner of Public Service or his representative may inspect, test or seal any consumer's meter at all reasonable hours.

Section 5. Notification of Test. Paragraph 1. At least forty-eight (48) hours before the Commissioner of Public Service or his representative shall make any complaint test of any consumer's meter, the said Commissioner of Public Service shall send a written notification of such test to both the con-

sumer and the seller of electricity as stated in the receipt hereinbefore described. Such notification shall state the time when and the place where said test will be made. Any interested party or parties may be represented at any test of any consumer's meter.

Section 6. Sealing of Meters. Paragraph 1. Whenever any inspection, test or adjustment of any consumer's meter shall be made, the person or persons making such inspection, test or adjustment, shall so place a seal upon the said meter that the said meter cannot be changed, adjusted or opened in any way without breaking the said seal. The said seal shall indicate the month and the year when the said seal was placed on the said meter. No person except with the written permission of the Commissioner of Public Service shall remove, break, change or otherwise tamper with any consumer's meter bearing the seal of the said Commissioner of Public Service, or shall remove, break, change or otherwise tamper with the said seal.

Section 7. Fees for Tests. Paragraph 1. The following shall be the fee or fees charged by the Commissioner of Public Service for the making of any test of consumers' meters operating on circuits of 600 volts or less, to-wit:

Amperes. Rated Capacity.	Fees.
10 or less	\$ 1.50
Over 10 but not more than 15.....	2.00
Over 15 but not more than 25.....	2.50
And for each additional 25 amperes or fraction thereof.....	0.50

The following shall be the additional fee or fees charged by the Commissioner of Public Service for the making of any test of consumers' meters operating on circuits of more than 600 volts, to-wit:

Volts in Circuit.	Fees.
Over 600 but not more than 2,000.....	\$ 5.00
And for each additional 1,000 volts or fraction thereof.....	2.00

Paragraph 2. The fee or fees for any complaint test shall be paid by the seller when it is found that the meter of the said consumer is registering four percent (4%) or more above the amount of electricity actually passing through the same.

Section 8. Adjustment and Test of Meters. Paragraph 1. When any consumer's meter is tested as in this section provided and is found inaccurate, it shall be adjusted so as to register within one per cent (1%) any and all amounts of electricity passing through the said meter when such amounts are between ten percent (10%) of and one hundred percent (100%) of the rated capacity of the said meter. During the adjustment the voltage shall at all times be kept above ninety-five percent (95%) of the rated voltage of the said meter.

Paragraph 2. Any meter which cannot be adjusted as hereinbefore provided or any meter which "creeps" or registers when no electricity is passing through the same, shall be removed from service within thirty (30) days after notice thereof given by the Commissioner of Public Service, to the seller.

Paragraph 3. Meters shall be tested and their accuracy determined as follows:

The voltage in the circuit shall at all times during the test be kept above ninety-five percent (95%) of the rated voltage of the said meter. The first test shall be made at between ten percent (10%) of and twenty percent (20%) of the rated capacity of the said meter; and second test shall be made at what shall hereinafter be prescribed as the normal load of the said meter; and the third and last test shall be made at more than eighty percent (80%) of and less than one hundred per cent (100%) of the rated capacity of the said meter. The final test or tests shall be determined as follows: The result of the second test shall be multiplied by three and to this shall be added the result of the first and third tests and the sum so obtained shall be divided by five, giving the final result.

Paragraph 4. The normal load of a meter shall be determined in percentage of the rated capacity at the rated voltage by classification of the service as follows, to-wit:

Classification of Service.	Percentage of Rated Capacity.
Residence and apartment buildings.....	25%
Elevator Service	40%
Factories (individual drive), churches and offices.....	45%
Factories (shaft drive), theatres, clubs, entrances, hallways and general store lighting	60%
Saloons, restaurants, pumps, air compressors, ice machinery and moving picture machines	70%
Signs, window lighting and blowers.....	100%

Section 9. **Standard Meters.** Paragraph 1. There shall be maintained at all times in the office of the Commissioner of Public Service standard instruments for the measurement of electro-motive force and current, both alternating and direct, which instruments shall be accurate to within one-tenth (1/10th) of one (1%) percent when compared with the standards of the United States Bureau of Standards and the Department of Public Service shall have these instruments sealed and certified by the United States Bureau of Standards at least once in every six (6) months. The said instruments so maintained and kept shall be used as primary standards for the purpose of checking the working standards used by said Commissioner of Public Service.

Section 10. **Records and Reports.** Paragraph 1. Any person or persons, who shall under the provisions of this ordinance, make any test or adjustment of any consumer's meter, shall within thirty (30) days thereafter file with the Commissioner of Public Service a record of such test or adjustment on forms to be furnished by the said Commissioner of Public Service.

Paragraph 2. The Commissioner of Public Service shall keep a register or registers in his office in the City Hall in which he shall record the number and description of each consumer's meter inspected or tested by him or his representative and the time of such inspection or test and the condition of the said consumer's meter when inspected or tested. Such records shall be at any reasonable time open to any citizen of the City of Chicago.

Paragraph 3. The Commissioner of Public Service, immediately after the first of each month, shall prepare and submit to the City Comptroller a report of the number of consumers' meters tested during the previous calendar month.

Section 11. **Police Aid.** Paragraph 1. Whenever it shall, in the opinion of the Commissioner of Public Service or his representative, be necessary to call upon the Department of Police for aid or assistance in carrying out or enforcing any of the provisions of this ordinance, he shall have authority to do so, and it shall be the duty of the said Department of Police or any member thereof, when called upon by the said Commissioner of Public Service or his representative, to act in accordance with the instructions of and to perform such duties as may be required by him by legal measures to enforce or put into effect the provisions of this ordinance.

Section 12. **Penalty for Violations.** Paragraph 1. Any person or persons, firm, corporation, seller or consumer violating or refusing to comply with any of the provisions of this ordinance shall be fined not less than Twenty-Five (\$25.00) Dollars nor more than One Hundred (\$100.00) Dollars for each offense. A separate and distinct offense shall be held to have been committed each day any person, persons, firm, corporation, seller or consumer violates or fails to comply with the provisions of this ordinance.

Section 13. **Repeal of Previous Ordinance.** Paragraph 1. Sections 838, 839, 840, 841, 842, 843, 844 and 845 of the Civil Code of 1911 be and the same are hereby repealed.

Section 14. **Ordinance Effective.** Paragraph 1. This ordinance shall take effect and be in force from and after its passage and publication.

RATES.

In 1912, Mr. Ray Palmer, Commissioner of Gas and Electricity, made a thorough investigation of the Commonwealth Edison Company's valuation and rate schedules. The rates as recommended by Mr. Palmer and the changes in the Commonwealth Edison Company's rates thus brought about resulted in a material decrease in rates to consumers of electricity and the consequent sav-

ing to the citizens of many thousands of dollars. The fact that any system of rates is adequate as a basis of charge only as long as applied with the best of judgment and discretion was foreseen at this time, for we find that Mr. Palmer recommended "that maximum demand meters be not installed in future for retail light and power, except in cases where they appear necessary for statistical purposes, but that maximum demand be determined from present data and statistics revised from time to time as conditions demand."

Rate schedules for the sale of electricity must be made for a class of consumers, rather than the individual, and the basis of such rate should be the average demands of the class. Assuming that the average is properly determined, only those consumers whose demands fall at the average will be paying for the service in the exact proportion to the cost to supply such service.

That the rate schedules in force in Chicago may seem complicated is due to the fact that they are designed to allow the consumers who use electricity economically to obtain a lower rate than a consumer who is extravagant. The consumer who uses all his lights at one time and at the same time that everyone else is using their lights is, in so far as the company is concerned, not a profitable consumer. On the other hand the one who uses only a small number of lights at any one time but burns these lights for a great number of hours is a profitable consumer and should be granted a lower rate. Apparatus such as electric irons are also profitable for the company.

It is easy enough to determine how many lights a consumer has been using at one time during the month but to find out just when he used these lights is not possible. Hence, from the standpoint of the consumer, economy can be gained only by exercising care and using as few lamps as possible at any one time.

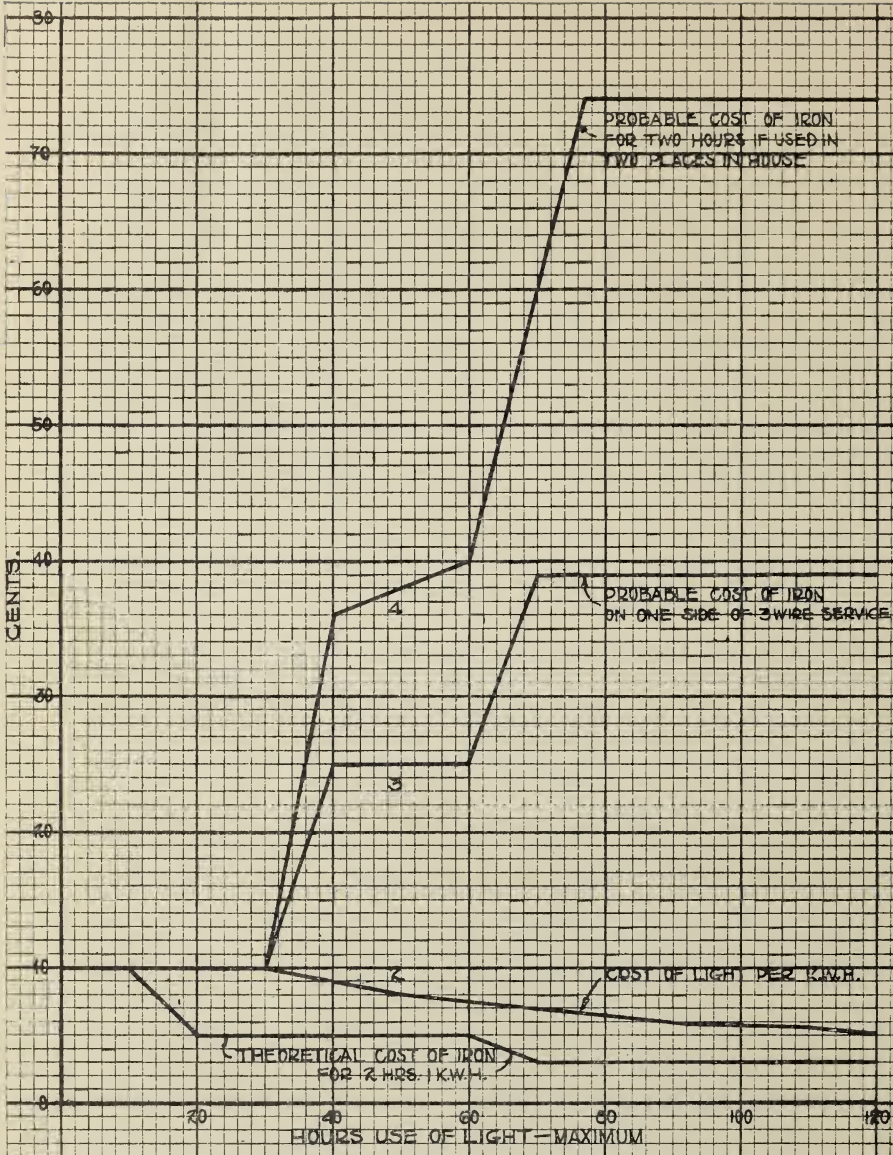
An analysis of the "General Service" schedule of the Commonwealth Edison Company as shown on the accompanying set of curves, illustrates the probable effect on residence lighting bills of variation in the method of determining the maximum demand. A complete analysis of the rate would involve the making of a very great number of calculations. Only one case is here treated. This case deals with the consumer having 1,500 watts connected loads in lights and using an electric iron. The lower curve shows the price the consumer is supposed to pay for using an iron for two hours per month. When the maximum demand is determined from a table, this cost ranges from 10 cents down to 3 cents. It is, however, practically impossible for a residence consumer having a maximum demand meter to obtain this rate.

Should there be installed maximum demand meters and if the service is three wire, the cost rises to a range of 10 to 39 cents for two hours' use as shown by curve 3. Should the housewife desire to enjoy the sunshine or the breeze and for this purpose remove her ironing to another part of the house, if only for a few minutes, the meter bill may now show up 35 cents larger than if she had stayed in the kitchen and 74 cents larger than if she had used no iron at all. If the iron used be one consuming 600 watts instead of 500, the latter figure will be increased to \$1.28. If lights are turned on when the iron is on, the bill will be further increased.

Some note of warning might be sounded but it is feared the housewife would learn to fear the harmless electric iron.

One consumer who entered a complaint with the department has found it to his interest to install Mazda lamps in place of the formerly used carbon lamps. He will save enough in one month to more than pay for the new lamps. Much good can be done for consumers by the establishment of a source of information along these lines. The Electric Bureau is endeavoring to so extend its field of usefulness.

COST OF USING AN ELECTRIC IRON



ISSUED BY THE
DEPT. OF PUBLIC SERVICE
 CITY OF CHICAGO
 APPROVED *M. J. King*
 DATE *SEPT. 24 1914*

COMPLAINTS.

No. 2,404. **Condemned Wiring.** Complainant wished to evade order of Inspection Department. Referred to Department of Gas & Electricity for re-inspection. Condemnation confirmed.

No. 2,432. **Disputed Bills.** Increase of consumption billed at high rate. C. E. Co. asked for rating and amount of bills. Investigation showed that consumer had connected load exceeding $1\frac{1}{2}$ k. w. and that company had installed maximum demand meter. Bills were rendered correctly from the demand meter readings.

No. 2,433. **Abandoned Poles.** Complainant desired to have old poles removed from street. Notice was issued to the C. E. Co. to remove poles. Poles were removed.

No. 2,436. **Meter Test.** Application blank was furnished. Blank was not returned and no test made.

No. 2,437. **Service Extension.** C. E. Co. apparently had refused service. Referred to company. Extension was found to be delayed by necessity of obtaining private property permits for lines.

No. 2,438. **Street Lighting.** A lamp reported out of order and not burning. Referred to Department of Gas & Electricity.

No. 2,439. **Hall Lighting.** Complainant stated that no hall lights were maintained in an apartment building. Referred to Department of Health.

No. 2,440. **Disputed Bill.** Consumer desired a maximum demand meter installed in his residence on the grounds that the estimated maximum demand was too high. Taken up with Public Service Co. of Nor. Ills. and C. E. Co., the latter installing the maximum demand meter.

No. 2,441. **Disputed Bill.** Increase of consumption billed at high rate. Referred to C. E. Co. for connected load. Investigation showed that company had been billing less than the estimated maximum demand corresponding to the connected load.

No. 2,442. **Service Deposit.** Company making charge of \$15.00 to install service in garage of consumer. Taken up with company with explanation that the garage was located at another address. Company replied that charge was made in error, thinking that garage was on same premises.

No. 2,443. **Meter Test.** Bills considered too high by consumer and application blank furnished and meter tested. Found to be correct and explanation of probable correctness of bills furnished consumer.

No. 2,444. **Meter Test.** Application blank furnished. Blank not returned and no test made.

No. 2,445. **Disputed Bills.** Consumer had two service connections; one being equipped with demand meters and the other not. Consumer objected to company adding the maximum demands and billing on basis of the sum. Referred to C. E. Co. on basis of separate contracts and asked for separate bills. Investigation showed that the consumer had signed waiver of power contract and company was justified in billing as had been practised. Company ordered consumer to remove lights from power circuit and sign a power contract.

No. 2,446. **Meter Test.** Consumers' bills were increasing. Meter tested and found to be 80% accurate and showed evidence of having been tampered with. Windings of the consumers' motor were found to be water soaked and motor consumed full load current when running light.

No. 2,447. **Rate Explanation.** Consumer desired outline of method of determining rates for lighting service. Information furnished.

No. 2,448. **Meter Test.** Application blank not returned. No test.

No. 2,449. **Service Delay.** Consumer stated that company was delaying in furnishing service provided for. Taken up with company. They stated service had been completed on the day previous.

No. 2,451. **Disputed Bills.** Complainant objected to bills on account of high maximum demand indicated. Explained to consumer that bills apparently were correct and suggested that the load turned on at any one time be reduced.

No. 2,452. **Meter Test.** Consumer objected to high bills and stated that meter was being tampered with by the owner of the building who furnished the current. Meter was tested and found to be 110.7% accurate and driving dog was missing from the register.

No. 2,453. **Meter Test.** Consumer complained of exorbitant bill. Meter was tested and found to be 93.8% accurate and was recording energy passing through a leak in the wiring.

No. 2,454. **Meter Test.** Consumer complained of exorbitant bill. Meter was tested and found to be 102.5% accurate and was recording a heavy current leakage in the wiring.

No. 2,455. **Disputed Bills.** Back bill for energy was rendered a consumer by the C. E. Co. who stated that the bills rendered for the past 3½ years were approximately 1/10th of correct bills, due to error in reading by the company's meter readers. An investigation showed that the bills paid by the consumer were approximately 1/10th of the consumer's estimated consumption. Explained the situation to the consumer and suggested that he accept the company's offer of compromising the bill.

No. 2,456. **Disputed Bills.** Consumer complained of high maximum demand charged for on bills. Bills analyzed and method of determining maximum demand explained to consumer.

No. 2,457. **Street Lighting.** Consumer desired street lights to be placed in vicinity of his residence. Referred to Dept. of Gas and Electricity.

No. 2,458. **Rates.** Lower rates desired for Calumet Park Commission. Complainant requested us to furnish statement of the connected load. No reply received and complaint still open for action.

No. 2,459. **Service Extension.** Petition for telephone and electric lighting service made by number of citizens. Investigation made and plats of the vicinity referred to C. E. Co. and C. T. Co. Companies replied that the cost of extension was not justified by the returns.

No. 2,460. **Service Refused.** Complainant stated that company refused service account of unpaid bills rendered to her mother. Upon investigation by the department the consumer stated that the company had agreed to furnish service.

No. 2,461. **Disputed Bills.** A consumer refused to pay electric bills on the grounds that other circuits besides his own were connected to the meter. The company discontinued the service of the consumer on account of the unpaid bills. The department investigated conditions and found that the other circuits had been removed from the meter in the meantime by the company. The C. E. Co. was asked to compromise the bill. The bill was compromised for \$1.00 and the consumer's service again connected.

No. 2,462. **Meter Wiring.** Consumer stated that meter had been incorrectly connected. Investigation by the department indicated that meter was connected correctly.

No. 2,463. **Service Extension.** Deposit requested by C. E. Co. for extension of lines to furnish service. Plat of vicinity made and referred to C. E. Co. Company refused to furnish service without deposit for an extension.

No. 2,464. **Service Extension.** (Same as No. 2,463.)

No. 2,465. **Construction Charge.** C. E. Co. lines were transferred from street to alley. Consumer objected to charge of C. E. Co. for removing interior service connection to rear of residence. Investigated by this department and explanation given consumer that the C. E. Co. were not required to make changes on interior wiring to accommodate service entrance.

No. 2,466. **Service Discontinuation.** C. E. Co. notified consumer that service would be discontinued unless bills of predecessor were paid. Investigation by this department showed that company had not rendered bills to the previous consumer. Company was asked to render the bills to the predecessor who promptly paid them and relieved the inconvenience of the complainant.

No. 2,467. **Inspection Charges.** Complainant objected to reinspection charges made by Inspection Bureau of the Dept. of Gas and Electricity. Explanation settled complaint.

No. 2,468. **Meter Test.** Consumer objected to high bills. Meter tested and found correct.

No. 2,469. **Disputed Bills and Meter Test.** Consumer objected to bills for electric service, stating that no current had been used. Bills were investi-

gated and found to agree with estimates of current consumption based on weather bureau reports of sunshine and cloud records. Meter was tested and found accurate.

No. 2,470. **Disputed Bills.** Consumer objected to high maximum demand. Bills were analyzed and found to be apparently correct.

No. 2,471. **Guarantee for Bills.** Consumer objected to making guarantee deposit for bills at time of application for service. Referred to company who stated that deposit would not be required if consumer furnished references. Consumer notified.

No. 2,472. **Disputed Bills.** Consumer complained of high bills, stating that his consumption had been much less. An estimate of the consumption by this department was found to agree with the bill rendered. Explanation accepted.

No. 2,473. **Payment Facilities.** Complainant desired information for location of offices for payment of electric bills. Referred to company who stated that a list of such offices is printed on the reverse side of each bill and named several stations in the vicinity of the complainant's address. Reply of company forwarded to consumer.

No. 2,474. **Current Theft.** Consumer stated that another occupant of building had installed lights and had connected the circuit to the meter of the complainant. Investigation by the department found the circuit on the proper meter.

No. 2,475. **Service Refused.** Complainant stated over telephone that service was refused at complainant's address but withheld own name. Investigation by this department showed that the building was receiving service.

No. 2,476. **Subway Lighting.** The complainant objected to unlighted subways in the vicinity of his residence and desired information as to when such lighting would be completed. Referred to Dept. of Gas and Electricity and information forwarded to complainant.

No. 2,477. **Disputed Bills.** Consumer complained of high maximum demand on bills rendered. Bills were analyzed by the department and the consumer advised to reduce his connected load by change of lamps and apply for removal of maximum demand meter.

No. 2,478. **Overhead Wires.** Petition by property owners to have overhead wires placed underground in an alley about to be paved. Referred to Dept. of Public Works.

No. 2,479. **Service Extension.** Deposit required by C. E. Co. for line extension to supply service. Investigated and referred to C. E. Co. with plat of vicinity. C. E. Co. refused to make extension without deposit.

No. 2,480. **Meter Test.** Consumer complained of high bills. Meter tested and found 92.3% accurate. Advised consumer to reduce consumption by substitution of Tungsten lamps for carbon lamps.

No. 2,481. **Service Extension.** (Same as No. 2,479.)

No. 2,482. **Street Lighting.** Street lamp out of order and not burning. Referred to Dept. of Gas and Electricity.

No. 2,483. **Service Extension.** C. E. Co. required deposit for extension of line to furnish service. Investigated and plat of vicinity referred to C. E. Co. with explanation that line extension was unnecessary. C. E. Co. agreed to install service as suggested without deposit.

No. 2,484. **Service Delay.** Service connection was delayed in the routine of C. E. Co. Company notified of delay and service was installed same day.

No. 2,485. **Service Refused.** C. E. Co. refused service to applicant until wiring had been put into serviceable condition. Consumer did not wish to comply with request of the company. Investigation made by the department and consumer advised to comply.

No. 2,486. **Street Lighting.** Consumer objected to arc lamp in front of residence shining into bedroom and desired to have shade placed on lamp. Referred to Dept. of G. & E., who replied that shade would not be installed.

No. 2,487. **Discontinuation of Service.** Consumer had two contracts. One for interior lighting and one for street lamp post. Desired to discontinue the latter but C. E. Co. stated that service under the interior lighting contract would be discontinued unless payments were continued under the street lamp contract. Referred to Corporation Counsel.

No. 2,488. **Service Failure.** Complainant stated that his electric lighting service failed at various times. The fault could not be located by C. E. Co.

Investigation by this department showed that a defective link fuse and loose connection caused the trouble. Above defects remedied.

No. 2,489. **Street Lighting.** Complainant desired to have shades removed from street lamps. Referred to Dept. of G. & E., who replied that shades would be removed.

No. 2,490. **Service Extension.** C. E. Co. required a deposit for line extension to furnish service. Investigated and referred to C. E. Co., who refused service connection without deposit. This department referred to C. E. Co. a written promise to the consumer to install service and company agreed to install same.

No. 2,491. **Disputed Bills.** Consumer complained of high bills, stating that his consumption had not been equal to the minimum charge. Investigation by this department showed that the consumption was less than the minimum charge and the company was asked to rectify the bills. In reply the company stated that error had been made and rectified bills were issued to consumer.

No. 2,492. **Meter Test.** Complainant objected to high bills. Meter tested and found 101.7% accurate.

No. 2,493. **Rates.** Consumer objected to paying full rate for service when entitled to municipal rate. Negotiations pending.

No. 2,494. **Condemned Wiring.** Complainant desired to have wiring inspected by this department. Investigation was made and condemnation found to be justifiable.

No. 2,495. **Service Delay.** Consumer complained that C. E. Co. was delaying in supplying service. Investigation showed that no application had been filed by the consumer for service. Consumer notified to file application.

No. 2,496. **Service Extension.** Deposit required for line extension. Under investigation.

No. 2,497. Same as No. 2,496.

No. 2,498. **Street Lighting Pole.** Complainant stated that basement was flooded due to setting an electric street lamp pole on curb. Investigation showed that basement was flooded as a result of stopped up sewer. Referred to Dept. of Public Works.

No. 2,499. **Service Extension.** (Same as No. 2,496.)

No. 24,100. **Lamp Renewal.** Consumer stated that C. E. Co. would not furnish lamp renewals. Investigation showed that the company had in their possession a signed receipt for lamps delivered to complainant's address. Company delivered another set of lamps for renewal.

No. 24,101. **Service Delay.** Complainant stated that four weeks had elapsed since filing application for service. Desired to have service as soon as possible. Referred to Dept. G. & E. for inspection certificate and taken up with C. E. Co. Company installed service on the following day.

No. 24,102. **Service Entrance.** Contractor wished information on installing service to building not accessible to a service drop from C. E. Co. lines in alley. Informed that service conduit to obtain service would not be installed by C. E. Co.

No. 24,103. **Service Increase.** Complainant objected to deposit required by C. E. Co. for reinforcing of lines necessary to supply desired increase of load. Taken up with company who agreed to increase capacity of the service without charge.

No. 24,104. **Service Extension.** Deposit required for line extension to supply service. Under investigation.

No. 24,105. **Service Refused.** Complainant states that C. E. Co. has refused to supply service to his residence. Under investigation.

ELECTRIC SERVICE INSPECTION.

An investigation is being made by the Electric Bureau for the purpose of discovering the conditions under which electricity is bought and sold in Chicago. The areas covered up to the present time have been selected as including representative classes of business.

Those consumers who deal directly with and pay their bills to the Commonwealth Edison Company comprise 81 percent of the total. Such irregularities as have been found in metering or charges were adjusted by the company when brought to their attention.

It is found that about three percent of consumers are furnished by isolated plants, about one-half of whom are also owners. A considerable number of such consumers receive service from these plants without meters.

The class of consumers, about sixteen percent of the total, who are furnished by jobbers or middlemen, present an interesting problem. Landlords, agents or others supplying electricity to the tenants of buildings under a variety of terms of sale buy electricity from the Commonwealth Edison Company through a master meter and retail the same either through meters or by some other method of determination of the amount used. By reason of his position, the tenant is unable to deal direct with the company supplying the electricity. Rates vary from 3 cents to 15 cents per k.w.h., while the flat rates vary from \$2.00 per month up. In numerous instances, no information could be obtained as to rates, such rates including those where the tenant or consumer did not know his rate.

It seems to be customary in this class for the landlord to include the electric light bill in the rent. This gives the tenant no idea as to what he pays for current alone and does give the landlord an opportunity to make a profit on the sale of electricity. He, of course, knows the cost to himself wholesale and how much of his tenants' rent is chargeable to electricity. Where the highest rate is charged, the consumer is in ignorance of the rates provided by ordinance and the agent has often taken advantage of his ignorance.

Where the lowest rate, that of 3 cents, occurred, is a noteworthy case. An owner of a building, used for stores and manufacturing, purchases electricity for the entire building on a wholesale rate which has varied according to the information furnished by the agent, from 3 cents to 5 cents per k.w.h. Each tenant has an individual meter, which he owns personally, and the owner in his own plant in the building also has an individual meter for the plant. The elevator service is also metered by an individual meter. To determine the amount to be paid to the landlord by each tenant for electricity, the following is observed: from the total consumption shown by the master meter is subtracted the consumption shown by the elevator service meter. The remainder is divided pro rata among the tenants as shown by the consumption indicated by their separate meters. They then pay the landlord for their pro rata consumption at the rate that he has paid to the Commonwealth Edison Company. The more tenants in the building and the greater their consumption, the lower the rate. Both light and power are taken through the same master meter. No charge is made to tenants for the elevator service except that it may be accounted for as part of the rent. The tenants here are benefited by a much lower rate for electricity than other consumers of the same size and class.

Flat rates are in general established arbitrarily by the jobber without any reference to any established rating and may be to the advantage of the consumer on dark days and to his disadvantage on light days. In one instance where a landlord is furnishing light to 32 tenants, the rate, as nearly as could be estimated to the tenants paying for electricity with their rent, was 7 cents net per k.w.h., to two tenants \$2.00 flat per month; and to one other tenant a rate of 11 cents, 6 cents and 5 cents with 1 cent discount. This landlord is a heavy consumer, his lowest rate being as low as 1.1 cents per k.w.h. He not only makes a large profit on his sales of electricity, but his consumers help him to get a lower average wholesale rate due to an increased consumption.

In a few cases the tenants informed the inspector that they paid an amount fixed each month by the landlord, but as to how this amount was arrived at was not known to them.

About fifty percent of the consumers stated that their meters were to their knowledge tested recently and about fourteen percent stated that their meters were to their knowledge never tested. Approximately twenty-two percent stated that they did not know whether their meters were ever tested or not. The remaining fourteen percent never have their meters tested and there is no provision made for testing. This class is composed of those consumers who buy from individual plants or jobbers.

Their lack of knowledge of exact conditions governing the use and purchase of electricity and the wide variation in the rates indicates the neces-

sity for supervision over the service and the value of a well maintained system of meter inspection.

The vast majority of the consumers were ignorant of the fact that they could have recourse to the department in case of disputes or complaints regarding their electric service, and the wide variations in the rates at which electricity is sold has given this Bureau an opportunity to render valuable service to the public.

VOLTAGE REGULATION.

The factors which affect voltage variation are so numerous and of such nature as to render any general rule, placing specific limitations upon such voltage variation, regulation or fluctuation, inoperative in a great many, if not in the majority of cases. The question which arises is whether it would not be preferable to deal with quality of service in the same manner in which regulating bodies deal with rates, rather than to adopt a general rule which must be ignored or excepted in the cases as above cited.

The demand for close voltage regulation has arisen chiefly from the use of the incandescent electric lamp. The tendency with manufacturers has been to produce a lamp using less energy per unit of light and also less subject to variation with a decrease or increase in voltage.

Table showing effect of voltage variation on the operation of incandescent lamps.

Voltage.	(All values in per cent.)		
	Type.	Candle Power.	Life.
95%	Carbon	75.0	270
	Metalized	77.4	253
	Mazda	83.4	185
97%	Carbon	85.0	175
	Metalized	86.0	173
	Mazda	90.0	145
100%	Carbon	100	100
	Metalized	100	100
	Mazda	100	100
103%	Carbon	118.0	48
	Metalized	114.0	62
	Mazda	110.0	65
105%	Carbon	131.0	34
	Metalized	125.0	44
	Mazda	118.0	50

The failure to maintain a voltage regulation within certain limits may result in two sources of complaint of service. One due to a temporary decrease in voltage caused by the connection of heavy motors to the line or to the application of otherwise heavy load and having its effect before such motor has been started or before the feeder regulators have had time to operate. This produces an annoyance to the user of light in the way of a decreased illumination which lasts for only a few moments but which becomes increasingly annoying with its frequency of occurrence. The second source of complaint may be due to a decrease in illumination to the point when it is insufficient for the purpose for which it is used.

Any rule regarding voltage regulation would need to consider both conditions and it would seem desirable to specify the limit of time over which the maximum variation should last. To remedy the first mentioned condition would necessitate that the limiting clause include instantaneous variations. This would produce a condition of service which would not be demanded in certain localities due to the expense involved.

The demands for constant voltage is a demand for a steady and sufficient light and satisfactory operation of electrical apparatus.

The limits of satisfactory illumination for any given operation are widely separated, varying from 100% to 500%. To obtain a proper illumination under conditions of voltage variations it is only necessary to allow the proper amount in excess of the lower limit or that which is considered proper. The difference in illumination between 95% and 97% of normal voltage is 7%.

To raise the general requirement from 5% to 3% variation from standard would thus insure a 7% increased illumination from a given lighting installation of Mazda lamps. The same result can be obtained by allowing a 7% increase in the original installation or by increasing the size of existing lamps. The power cost need not be increased over 7%. To obtain an equivalent result by closer regulation (3%) would in many cases require an expenditure far in excess of this amount. This may be appreciated by considering the fact that power which can be generated for less than 1c per kilowatt hour must be sold for from 3 to 10 cents in order to provide the return which various regulating bodies have seen fit to grant.

The carbon lamp due to its high cost of operation should be considered as an obsolete type.

The various factors which are of prime importance in the design of electric transmission and distribution systems are largely ones of economic importance. The line losses, and therefore, to a corresponding extent, the line drop in pressure are governed by balancing the value of the saving of the energy lost in the line against the increased capital charges necessary to raise the voltage or to provide heavier copper.

In current practice for any but metropolitan districts, distribution circuits are designed for an 8 to 10 per cent loss and secondaries or services for a 2% loss. When there is added to this a 1% drop in the transformer in case of alternating current systems, we have under most favorable conditions (lighting load) a drop of from 11 to 13 per cent at the most economical load for the line. Under extreme conditions of load this drop will increase from 10 to 50 per cent (depending upon the load factor of the feeder), causing a maximum drop of from 12 to 20 per cent in the distribution system. The voltage fluctuation here produced would be of the same magnitude.

This voltage variation is met in practice by the installation of boosters or regulators on the feeders for the purpose of maintaining the voltage constant at some point near the center of load. Applied to the tree system of distribution, which is in use in many cities of from 10,000 to 20,000, the variation on the longer branches will yet exceed 50% of the above range of variation. Thus there is a variation of from 6 to 10 per cent on lighting circuits designed and operated on what is judged by competent engineers to be about the limit of economy, except where the load is very heavy.

That the demands of a 3% regulation can be met without unwarranted capital charges in dense metropolitan districts there may be no question, but to require less than a 5% regulation as applying to the entire service of a larger system is to call for the installation of numerous substations for transformation and control, and an enormous investment in copper.

In the smaller towns where service at reasonable rates can be supplied only by installing an outdoor substation, fed from a nearby transmission line and operating same without constant attendance, the problem of maintaining a service resolves itself into one of furnishing electricity at a rate at which the people can afford to use it, i. e., that of supplying something which is infinitely superior to what the community may have even though the regulation may not be good.

The production of an ever decreasing voltage variation can be made only at an ever increasing operating cost for attendance, and an increased investment, and therefore, an increasing capital charge.

It cannot be doubted that the reduction of the allowable voltage fluctuation to 3%, above or below a standard value, would necessitate the expenditure of large sums of money for equipment in many of the larger cities of the state. It is not to be supposed that capital would be reluctant to finance such necessary expenditures. Public utility securities have in general been put upon a firmer basis where adequate regulation exists and are considered safe for investment purposes. Any expenditure in plant or distribution which tends to improve the quality of service at no increased rate, or which tends to reduce the rate without impairment of quality can easily be justified. But if a rule is adopted requiring a regulation not demanded by the service, which adds to equipment and operating cost, its necessity or justice should be questioned. In future valuations for the purpose of regulating or fixing of rates these expenditures must be taken into consideration; not only for the increased cost of equipment, but in many cases for the replacement of equipment. Utility companies might be able to use the rule as a means of unduly

increasing capital charges and the rates to all would be raised for the benefit of the few who desire very close voltage regulation.

Should a rule be adopted limiting the allowable voltage variation to a specific value for all cases, one of three actions must result as follows:

1. The companies must comply with the rule.
2. The rule must be waived.
3. The Commission must overlook non-compliance with the rule.

Should the companies comply with the rule the managements of the companies are likely to remember, when charges for extravagance are brought against them, the unwise expenditures of money in an effort to produce, under Commission orders, a class and condition of service not demanded by the consumers.

Should it be found advisable to waive the rule a hearing must be granted to each case before any action can be taken. This would result in a larger number of cases coming before the Commission than would be the case if only just complaints of inadequate service were presented for hearing.

If the rule is overlooked by the Commission, it would become a target for persons wishing to make political capital by filing, with the Commission, complaints for minor violations.

After careful consideration by the Department of Public Service it is thought that the quality of service is a factor affecting rates to such an extent that it should be so treated by the Commission. This would eliminate the possibility of fixing any value for allowable voltage variation applicable to the general case.

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